

CLAIMS

1. A magnetic recording medium having a recording layer on a substrate,
comprising at least one signal region on the substrate,
5 wherein a surface roughness of the signal region is different from that of other than the signal region.
2. A magnetic recording medium having a recording layer on a substrate, comprising:
an under layer on the substrate; and
10 at least one signal region on the under layer,
wherein a surface roughness of the signal region is different from that of other than the signal region.
3. The magnetic recording medium according to Claim 2, wherein the under layer is
15 composed of a dielectric layer, a metal layer, a magnetic layer, or a thin film laminated thereof.
4. The magnetic recording medium according to any of Claims 1 to 3, wherein the signal region has a concave or convex shape.
- 20 5. The magnetic recording medium according to Claim 4, wherein microparticles are packed in the signal region.
6. The magnetic recording medium according to Claim 5, wherein the microparticles are a self-organizing organic compound.
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7. The magnetic recording medium according to any of Claims 1 to 6, wherein the signal region comprises pre-pits having a surface roughness Ra of 0.5 nm or more, and the surface roughness of the other than the signal region is constant and less than 0.5 nm.
- 30 8. The magnetic recording medium according to any of Claims 1 to 6, wherein the signal region comprises pre-pits having a surface roughness Ra of 0.5 nm or less, and the surface roughness of the other than the signal region is constant and more than 0.5 nm.

9. The magnetic recording medium according to any of Claims 1 to 8, wherein the recording layer is composed of a magnetic film having magnetic anisotropy in the direction perpendicular to the film plane.

5 10. The magnetic recording medium according to Claim 9, wherein a reproduction layer, to which a recording magnetic domain formed on the recording layer is transferred, and to which the magnetic wall of the transferred recording magnetic domain moves during the reproduction of recorded information, is further provided over the recording layer.

10 11. The magnetic recording medium according to any of Claims 1 to 10, wherein the signal region has pre-pits that serve as a reference for a tracking servo of a recording and reproduction magnetic head.

15 12. The magnetic recording medium according to Claim 11, wherein the pre-pits that serve as a reference for the tracking servo of the recording and reproduction magnetic head have a concave/convex pattern that is smaller than the smallest pattern in the recording magnetic domain formed in the recording layer.

20 13. The magnetic recording medium according to any of Claims 1 to 12, wherein the maximum diameter of the signal region is 0.5 μm or less.

14. A method for manufacturing a magnetic recording medium having a recording layer on a substrate, comprising,
forming at least one signal region by etching on the substrate such that the surface roughness
25 of the signal region is different from the surface roughness of the other than the signal region.

15. The method for manufacturing a magnetic recording medium according to Claim 14 comprising, increasing the surface roughness of the magnetic recording medium by etching.

30 16. The method for manufacturing a magnetic recording medium according to Claim 14 comprising, smoothing the surface roughness of the magnetic recording medium by etching.

17. The method for manufacturing a magnetic recording medium according to Claim 14 comprising, smoothing the recording layer surface by etching after forming the recording layer.

18. The method for manufacturing a magnetic recording medium according to Claim 14, comprising,

forming pre-pits on a stamper by etching the stamper surface; and

5 forming the signal region whose surface roughness is different from that of the other than the signal region by transferring the pre-pits onto the substrate.

19. The method for manufacturing a magnetic recording medium according to any of Claims 14 to 18, comprising performing the etching after first coating the etching surface with
10 microparticles.

20. The method for manufacturing a magnetic recording medium according to any of Claims 14 to 19, wherein the etching is ion etching, plasma etching, or another such type of dry etching.
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21. The method for manufacturing a magnetic recording medium according to Claim 18 comprising, performing the transfer by imprinting.

22. The method for manufacturing a magnetic recording medium according to Claim 18
20 comprising, performing the transfer by heating.

23. The method for manufacturing a magnetic recording medium according to Claim 18, wherein the pre-pits formed in the stamper are transferred onto a resin formed on the substrate.

25 24. The method for manufacturing a magnetic recording medium according to any of Claims 14 to 23 comprising, forming a servo signal on the magnetic recording medium using the signal region as a reference signal.

30 25. An apparatus for manufacturing a magnetic recording medium having a recording layer on a substrate, the apparatus comprising:

a recording layer formation component for forming on a substrate a recording layer composed of a magnetic film having magnetic anisotropy in the direction perpendicular to the film plane; and

a region formation component for forming at least one signal region on a substrate by etching, such that the surface roughness of that signal region is different from that of the other than the signal region.

5 26. A method for recording to a magnetic recording medium having a recording layer on a substrate, comprising:
 detecting a difference in magnetic characteristics from a difference in surface roughness;
 forming a servo reference signal on the basis of the difference in magnetic characteristics; and
10 recording an information signal to the magnetic recording medium by irradiating with a laser beam while applying a tracking servo.

 27. A method for reproducing from a magnetic recording medium having a recording layer on a substrate, comprising:
 forming a servo reference signal while raising the temperature of the recording layer by
15 irradiating the magnetic recording medium with a laser beam; and
 reproducing an information signal from the magnetic recording medium by irradiating with a laser beam while applying a tracking servo.

20 28. An apparatus for recording to and reproducing from a magnetic recording medium having a recording layer on a substrate, the apparatus comprising:
 a magnetic head for recording and reproducing an information signal to or from a magnetic recording medium by irradiating with a laser beam;
 an optical head for irradiating the magnetic recording medium with a laser beam during the reproduction of the information signal;
25 a magnetic head control and detection component for controlling the magnetic head and detecting a difference in magnetic characteristics from a difference in surface roughness;
 a spindle motor for rotating the magnetic recording medium; and
 a motor drive and control circuit for controlling the rotation and drive of the spindle motor and controlling the tracking servo of the magnetic recording medium and a laser beam.